NAG Library Function Document

nag_dwaxpby (f16ehc)

1 Purpose

nag_dwaxpby (f16ehc) computes the sum of two scaled vectors, preserving input, for real scalars and vectors.

2 Specification

```
#include <nag.h>
#include <nagf16.h>
void nag_dwaxpby (Integer n, double alpha, const double x[], Integer incx,
     double beta, const double y[], Integer incy, double w[], Integer incw,
     NagError *fail)
```

3 Description

nag_dwaxpby (f16ehc) performs the operation

$$w \leftarrow \alpha x + \beta y,$$

where x and y are n-element real vectors, and α and β are real scalars.

4 References

Basic Linear Algebra Subprograms Technical (BLAST) Forum (2001) *Basic Linear Algebra Subprograms Technical (BLAST) Forum Standard* University of Tennessee, Knoxville, Tennessee http://www.netlib.org/blas/blast-forum/blas-report.pdf

5 Arguments

1: **n** – Integer *Input*

On entry: n, the number of elements in x, y and w.

Constraint: $\mathbf{n} \geq 0$.

2: **alpha** – double *Input*

On entry: the scalar α.

3: **x**[dim] – const double *Input*

Note: the dimension, *dim*, of the array **x** must be at least $\max(1, 1 + (\mathbf{n} - 1) \times |\mathbf{incx}|)$.

On entry: the n-element vector x.

If $\mathbf{incx} > 0$, x_i must be stored in $\mathbf{x}[(i-1) \times \mathbf{incx}]$, for $i = 1, 2, \ldots, \mathbf{n}$.

If $\mathbf{incx} < 0$, x_i must be stored in $\mathbf{x}[(\mathbf{n} - i) \times |\mathbf{incx}|]$, for $i = 1, 2, \ldots, \mathbf{n}$.

Intermediate elements of **x** are not referenced. If $\mathbf{n} = 0$, **x** is not referenced and may be **NULL**.

4: **incx** – Integer *Input*

On entry: the increment in the subscripts of **x** between successive elements of x.

Constraint: $\mathbf{incx} \neq 0$.

5: **beta** – double *Input*

On entry: the scalar β.

6: **y**[dim] – const double *Input*

Note: the dimension, *dim*, of the array **y** must be at least $\max(1, 1 + (\mathbf{n} - 1) \times |\mathbf{incy}|)$.

On entry: the n-element vector y.

If **incy** > 0, y_i must be stored in **y**$[(i-1) \times \mathbf{incy}]$, for $i = 1, 2, \ldots, \mathbf{n}$.

If **incy** < 0, y_i must be stored in **y**$[(\mathbf{n} - i) \times |\mathbf{incy}|]$, for $i = 1, 2, \ldots, \mathbf{n}$.

Intermediate elements of **y** are not referenced. If $\beta = 0.0$ or $\mathbf{n} = 0$, **y** is not referenced and may be **NULL**.

7: **incy** – Integer *Input*

On entry: the increment in the subscripts of **y** between successive elements of y.

Constraint: **incy** $\neq 0$.

8: **w**[dim] – double *Output*

Note: the dimension, *dim*, of the array **w** must be at least $\max(1, 1 + (\mathbf{n} - 1) \times |\mathbf{incw}|)$.

On exit: the n-element vector w.

If **incw** > 0, w_i is in **w**$[(i-1) \times \mathbf{incw}]$, for $i = 1, 2, \ldots, \mathbf{n}$.

If **incw** < 0, w_i is in **w**$[(\mathbf{n} - i) \times |\mathbf{incw}|]$, for $i = 1, 2, \ldots, \mathbf{n}$.

Intermediate elements of **w** are not referenced.

9: **incw** – Integer *Input*

On entry: the increment in the subscripts of **w** between successive elements of w.

Constraint: **incw** $\neq 0$.

10: **fail** – NagError * *Input/Output*

The NAG error argument (see Section 2.7 in How to Use the NAG Library and its Documentation).

6 Error Indicators and Warnings

NE_ALLOC_FAIL

Dynamic memory allocation failed.
See Section 2.3.1.2 in How to Use the NAG Library and its Documentation for further information.

NE_BAD_PARAM

On entry, argument ⟨*value*⟩ had an illegal value.

NE_INT

On entry, **incw** $= \langle value \rangle$.
Constraint: **incw** $\neq 0$.

On entry, **incx** $= \langle value \rangle$.
Constraint: **incx** $\neq 0$.

On entry, **incy** $= \langle value \rangle$.
Constraint: **incy** $\neq 0$.

On entry, $\mathbf{n} = \langle value \rangle$.
Constraint: $\mathbf{n} \geq 0$.

NE_INTERNAL_ERROR

An unexpected error has been triggered by this function. Please contact NAG.
See Section 2.7.6 in How to Use the NAG Library and its Documentation for further information.

NE_NO_LICENCE

Your licence key may have expired or may not have been installed correctly.
See Section 2.7.5 in How to Use the NAG Library and its Documentation for further information.

7 Accuracy

The BLAS standard requires accurate implementations which avoid unnecessary over/underflow (see Section 2.7 of Basic Linear Algebra Subprograms Technical (BLAST) Forum (2001)).

8 Parallelism and Performance

nag_dwaxpby (f16ehc) is not threaded in any implementation.

9 Further Comments

None.

10 Example

This example computes the result of a scaled vector accumulation for

$$\begin{aligned} \alpha &= 3, & x &= (-6, 4.5, 3.7, 2.1, -4)^{\mathrm{T}}, \\ \beta &= -1, & y &= (-5.1, -5, 6.4, -2.4, -3)^{\mathrm{T}}. \end{aligned}$$

x and y, and also the sum vector w, are stored in reverse order.

10.1 Program Text

```
/* nag_dwaxpby (f16ehc) Example Program.
 *
 * NAGPRODCODE Version.
 *
 * Copyright 2016 Numerical Algorithms Group.
 *
 * Mark 26, 2016.
 */

#include <stdio.h>
#include <nag.h>
#include <nag_stdlib.h>
#include <nagf16.h>

int main(void)
{
  /* Scalars */
  Integer exit_status, i, incw, incx, incy, iw, ix, iy, n;
  double alpha, beta;
  /* Arrays */
  double *w = 0, *x = 0, *y = 0;
  /* Nag Types */
  NagError fail;

  exit_status = 0;
  INIT_FAIL(fail);
```

```
  printf("nag_dwaxpby (f16ehc) Example Program Results\n\n");

  /* Skip heading in data file */
#ifdef _WIN32
  scanf_s("%*[^\n] ");
#else
  scanf("%*[^\n] ");
#endif
  /* Read number of elements */
#ifdef _WIN32
  scanf_s("%" NAG_IFMT "%*[^\n] ", &n);
#else
  scanf("%" NAG_IFMT "%*[^\n] ", &n);
#endif
  /* Read increments */
#ifdef _WIN32
  scanf_s("%" NAG_IFMT "%" NAG_IFMT "%" NAG_IFMT "%*[^\n] ", &incx, &incy,
          &incw);
#else
  scanf("%" NAG_IFMT "%" NAG_IFMT "%" NAG_IFMT "%*[^\n] ", &incx, &incy,
        &incw);
#endif
  /* Read factors alpha and beta */
#ifdef _WIN32
  scanf_s("%lf%lf%*[^\n] ", &alpha, &beta);
#else
  scanf("%lf%lf%*[^\n] ", &alpha, &beta);
#endif

  if (n > 0) {
    /* Allocate memory */
    if (!(w = NAG_ALLOC(MAX(1, 1 + (n - 1) * ABS(incw)), double)) ||
        !(x = NAG_ALLOC(MAX(1, 1 + (n - 1) * ABS(incx)), double)) ||
        !(y = NAG_ALLOC(MAX(1, 1 + (n - 1) * ABS(incy)), double)))
    {
      printf("Allocation failure\n");
      exit_status = -1;
      goto END;
    }
  }
  else {
    printf("Invalid n\n");
    exit_status = 1;
    goto END;
  }

  /* Read the vectors x and y and store forwards or backwards
   * as determined by incx (resp. incy). */
  for (i = 0, ix = (incx > 0 ? 0 : (1-n)*incx); i < n; i++, ix += incx)
#ifdef _WIN32
    scanf_s("%lf", &x[ix]);
#else
    scanf("%lf", &x[ix]);
#endif
#ifdef _WIN32
  scanf_s("%*[^\n] ");
#else
  scanf("%*[^\n] ");
#endif

  for (i = 0, iy = (incy > 0 ? 0 : (1-n)*incy); i < n; i++, iy += incy)
#ifdef _WIN32
    scanf_s("%lf", &y[iy]);
#else
    scanf("%lf", &y[iy]);
#endif
#ifdef _WIN32
  scanf_s("%*[^\n] ");
#else
  scanf("%*[^\n] ");
#endif
```

```
  /* nag_dwaxpby (f16ehc).
   * Performs w := alpha*x + beta*y  */
  nag_dwaxpby(n, alpha, x, incx, beta, y, incy, w, incw, &fail);

  if (fail.code != NE_NOERROR) {
    printf("Error from nag_dwaxpby (f16ehc).\n%s\n", fail.message);
    exit_status = 1;
    goto END;
  }

  /* Display the vector w forwards or backwards
   * as determined by incw. */
  printf("Result of the scaled vector addition is\n");
  printf("w = (");
  for (i = 0, iw = (incw > 0 ? 0 : (1-n)*incw); i < n; i++, iw += incw)
    printf("%9.4f%s", w[iw], (i < n-1 ? ", " : ")\n"));

END:
  NAG_FREE(w);
  NAG_FREE(x);
  NAG_FREE(y);

  return exit_status;
}
```

10.2 Program Data

```
nag_dwaxpby (f16ehc) Example Program Data
  5                                                    : n
  1   1   1                                            : incx, incy and incw
  3.0   -1.0                                           : alpha and beta
  -4.0   2.1   3.7   4.5   -6.0                        : Vector x
  -3.0   -2.4   6.4   -5.0   -5.1                      : Vector y
```

10.3 Program Results

```
nag_dwaxpby (f16ehc) Example Program Results

Result of the scaled vector addition is
w = (  -9.0000,    8.7000,    4.7000,   18.5000,  -12.9000)
```